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DIAGENETIC MINERALOGY AT GALE CRATER, MARS

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Three years into exploration of sediments in Gale crater on Mars, the Mars Science Laboratory rover *Curiosity*has provided data on several modes and episodes of diagenetic mineral formation. *Curiosity* determines mineralogy principally by X-ray diffraction (XRD), but with supporting data from thermal-release profiles of volatiles, bulk chemistry, passive spectroscopy, and laser-induced breakdown spectra of targeted spots. Mudstones at Yellowknife Bay, within the landing ellipse, contain ~20% phyllosilicate that we interpret as authigenic smectite formed by basalt weathering in relatively dilute water, with associated formation of authigenic magnetite as in experiments by Tosca and Hurowitz [Goldschmidt 2014]. Varied interlayer spacing of the smectite, collapsed at ~10 Å or expanded at ~13.2 Å, is evidence of localized diagenesis that may include partial intercalation of metal-hydroxyl groups in the ~13.2 Å material. Subsequent sampling of stratigraphically higher Windjana sandstone revealed sediment with multiple sources, possible concentration of detrital magnetite, and minimal abundance of diagenetic minerals. Most recent sampling has been of lower strata at Mount Sharp, where diagenesis is widespread and varied. Here XRD shows that hematite first becomes abundant and products of diagenesis include jarosite and cristobalite. In addition, bulk chemistry identifies Mg-sulfate concretions that may be amorphous or crystalline.

Throughout *Curiosity's* traverse, later diagenetic fractures (and rarer nodules) of mm to dm scale are common and surprisingly constant and simple in Ca-sulfate composition. Other sulfates (Mg,Fe) appear to be absent in this later diagenetic cycle, and circumneutral solutions are indicated. Equally surprising is the rarity of gypsum and common occurrence of bassanite and anhydrite. Bassanite, rare on Earth, plays a major role at this location on Mars. Dehydration of gypsum to bassanite in the dry atmosphere of Mars has been proposed but considered unlikely based on lab studies of dehydration kinetics in powdered samples. Dehydration is even less likely for bulk vein samples, as lab data show dehydration rates one to two orders of magnitude slower in bulk samples than in powders. On Mars, exposure ages of 100 Ma or more may be a significant factor in dehydration of hydrous phases.

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